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ZOOBENTHOS INVESTIGATIGATIONS IN THE SALINE WATERS OF THE GREAT HUNGARIAN PLAIN

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Summary

The results of evaluation of zoobenthos investigations can be summarized in short as follows: The bottom fauna of the three natron lakes lying close enough to one another differ from one another both in quantitative and qualitative. The zoobenthos production of the bottom covered with higher vegetation close to the water-side is unambiguously higher than that of the vegetation-free bed of the lake. Desiccation is tolerated most of all by Diptera (Brachycera) larvae. The favourable light-climate influences the development of the zoobenthos positively as well. The uneven distribution of animals may be caused by the heterogenity of sediment types. 89 per cent of the investigated organisms can be found in the upper 5 cm layer of the bottom.

Introduction

The Hungarian saline waters are extremely labile ecosystems. The determining of them is their shallowness and astatic character, resulting in their considerable dependence on their neighbourhood.

The quantity and qualitative composition of their living world are determined by the annual, seasonal, daily and even diurnal fluctuation of the (abiotic and biotic) active forces.

The characteristic for the saline water benthos number of individuals — as compared with that of the similarly productive back-waters and with that of the rivers seeming to be much poorer — is to be explaned from the following data. In saline waters, in a sole sampling of a collecting cylinder of 55,5 sq · cm surface and gripping 40 cm deep, the maximum individual number was 240 (this, converted to 1 sq · m surface, mean 43,224 individuals). In the Tisza Dead Arm, the maximum individual number is 45 (8104 speciemens per sq · m) in the Tisza 25 (4502 specimens per sq · m).

Examining the saline waters of the Hungarian Great Plain, the three natron lakes respectively are the objects No.-s. 13, 14, 15, the zoobenthos fauna of which was studied by the present article. The other results, concerning the zoobenthos investigations in saline waters (Nos. 1—12), were discussed in my three papers enumerated in the list of references (1971, 1973, 1977).

The dates of collections were: 2 April, 19 May, 2 June, 17 September, 13 November 1976, 13 April, 2 June, and 3 August 1977.

On each occasion, bottom samples were taken from two biotope-types: from one site near the water-side, covered with macrovegetation and from an open-water, vegetationless site farther from the water-side. At first sampling (2 April 1976) we took one per sites qualitaive, in all the other cases with a grab one quantitative sample each.

We have investigated the three saline waters according to the following points of view.

Observation of the qualitative and quantitative distributions of the zoobenthos fauna by measuring resp. investigating into certain abiotic factors (e.g., the change in water level, desiccation, freezing of water, its translucence, composition of the sediment).

Statement of the differences between the zoobenthos of the two biotope-types.

Seasonal investigations, population-dynamic investigations.

Materials and Methods

The bottom-samples were taken with a cylindrical grab. Each of the samples means a sediment layer of 55,5 sq. cm surface and 25—30 cm depth.

Leaching the matter in the laboratory through a 0,28 mm mesh metal sieve, we picked out the animals one by one with pincers from the remainder (selection 6,3x) and then fixed them in 6 per cent formalin.

From time to time, we took samples from the two biotope-types in order to investigate into the size of sediment granules. We have investigated into the change of sediment in vertical direction, as well separating the samples into 2,5 resp. 5 cm layers. After their drying in a thermostat, and separating them with the method of hydrometry we have studied the percentage of the single fractions. Measurements were carried out in the laboratory of the Department of Geology of the Attila József University in Szeged.

The fractions fell into the following types, resp. they had the following granule-diameters:

clay	0,001—0,005 mm
clayey mud	0,005—0,02 mm
mud	0,02 —0,05 mm
muddy sand	0,05 —0,1 mm
tiny sand	0,1 —0,2 mm
middle-sized sand	0,2 —0,5 mm

Characterisation of sampling sites

Kisréti-tó

It is a saline water of about 100 hectares area being the deepest of the three investigated lakes. At sampling sites (at the east side of the lake in the middle of its longitudinal axis) the maximum water depth was 50 cm.

Macrovegetation penetrates as far as the middle of the river bed. The open water surface of the eastern side is only 1/3. of the whole lake surface.

Although at some places the bottom is covered with 30 cm thick loose silt-layer according to the data of granule-size analysis the tiny sand fraction is the largest on the bottom of the lake; its 33,2 percentage is characteristic. There is submerged vegetation (*Ceratophyllum, Chara,* green algae) on the sediment rich in detritus as well.

The water is greenish-yellow, as a rule, it is transparent as far as the bottom (measured with Secchi disk). The favourable light climate and the alga rich in organic

detritus both qualitatively and quantitatively contribute to the formation of the most luxuriant zoobenthos.

The 1706 individuals, originating from twenty samplings, are taxonomically divided as follows:

	per cent
Oligochaeta	42,8
Chironomida	18,8
Ephemeroptera	16,8
Trichoptera	11,8
Nematoda	6,1
Ceratopogonida	1,8
Diptera (Brachycera)	0,7
Hirudinoidea	0,2
Odonata	0,2
Hemiptera	0,1
Coleoptera	0,1

Investigating only the living animals (i.e. taking no notice of the Mollusca shells, the empty Trichoptera tubes and the puparia of Diptera), we have found the following individual numbers per taxon-groups:

	individuals
Oligochaeta	434
Chironomida	41
Ephemeroptera	19
Ceratopogonida	12
Diptera (Brachycera)	5
Trichoptera	4
Hemiptera	2
Odonata	1
Coleoptera	1
Nematoda	1

This quantity means the average individual number per 28,8 samples.

Comparing the material taken from the open water with that taken from the vegetation close to the waterside, it is to be established that the latter biotope is populated approximately 2 times as densely (41,1 individuals per samples) as that in the open water (22 individuals).

The individual number of species forming the zoobenthos steadily decreases from spring till autumn. This decrease is ultimately determined by the population dynamics of the dominant Oligochaeta group. The individual number of Chironomida larvae was on the other hand, higher in autumn in the bottom samples. The same applies to the Ephemeroptera larvae, as well.

The Oligochaeta fauna of the Kisréti-tó:

Naididae:

Dero obtusa UDEK. (68 individuals)
Dero digitata GRUBE (6 ind.)
Stylaria lacustris JOHNSTON (12 ind.)
Nais variabilis PIG. (10 ind.)
Chaetogaster diaphanus ORST. (5 ind.)
Allonais sp. (2 ind.)

Tubificidae:

Limnodrilus profundicola BRINKH. (231 ind.)
Limnodrilus claparedeanus RATZ. (62 ind.)
Limnodrilus hoffmeisteri CLAP. (39 ind.)
Limnodrilus sp. juv. (124 ind.)

The dominant Tubificida: *Limnodrilus profundicola,* as well as the likewise dominant Naidida: *Dero obtusa* are a-mesosaprobic organisms.

In the biotope close to the waterside Oligochaetae formed a higher percentage of zoobenthos than bottom-samples in open water.

Kelemenszék

In this astatic lake of 456 hectares area, at the sampling sites of the north-western water-side: water-depth alternated between 1 to 25 cm. But in the lake, being dried out at the time of the sampling in August 1977, only some water-side and vegetation covered sites were covered with 1 cm deep water.

The macrovegetation at the water-side is scattered. The submergible vegetation was formed by *Chara* and *Nostoc* grasses.

On the bottom a 25—30 cm thick loose silty-clayey sediment was formed, dominating — over the other sediment types — in a ratio of 39,2 per cent according to the data of investigations.

The water was troubled, its transparence changed between 2,7—7 cm.

The ratio of distribution according to the taxon groups of 822 individuals, found in the total amount of samples is:

	percentage
Oligochaeta	34,4
Nematoda	29,9
Trichoptera	14,5
Ceratopogonida	13,0
Chironomida	4,4
Coleoptera	1,7
Diptera (Brachycera)	0,8
Odonata	0,5
Ephemeroptera	0,5
Hemiptera	0,2

In the quantative samples, the quantity of living animals was formed according to taxon groups, as follows:

	individuals
Nematoda	129
Ceratopogonida	16
Oligochaeta	6
Coleoptera	6
Chironomida	5
Diptera (Brachycera)	4

The above quantity means averagely 9,2 individuals per samples. This refers to a considerably lower zoobenthos individual-number as compared with the Kisréti-tó.

Comparing the bitope covered with vegetation, close to the water-side with that of the open water the individual number of zoobenthos in the former biotope is somewhat higher (10,7 ind.) than in the later (6,8 ind.).

Nematoda, as well as Ceratopogonida, live roughly in similar individual numbers in both biotope-types. The production of the vegetation zone at the water-side is hardly higher than that of the bottom under the open water. The quantity of the individuals of these two taxon groups is similar in our saline waters and that of the plantless places respectively (FERENCZ, 1973).

The seasonal distribution of the zoobenthos in Kelemenszék is just the reverse of that in Kisréti-tó. From spring, a slight increase in the total individual number is characteristic the maximum being in autumn. This, of course, coincides with the dynamics of the population of Oligocheates, determining the quantity; the increase in the individual number of Ceratopogonida larvae in autumn is also similar to this.

The summer drying out of the lake was survived by the larvae of Brachycera, of a comparatively higher tolerance. These larvae were only found on the occasion of sampling in August 1977, from the dried out bottom of the lake.

Oligochaeta of Kelemenszék :

Naididae: *Dero digitata* GRUBE (230 ind.)
Nais sp. (3 ind.)
Tubificidae: *Isochaeta michaelseni* BRINKH. (2 ind.)
Enchytraeidae: *Pachydrilus* sp. (1 ind.)

The dominant *Dero digitata* is an a-mesosaprobic organism, found in a very large individual number in the bottom samples, taken from the biotope of the lake-side.

Zabszék

Tha saline water of 32 hectares area, the lake-side macrovegetation zone of which the broadest in the western section, but in other places, e.g. at the sampling sites (at the northern side of the lake) is comparatively negligable. The sumbergible vegetation is formed by *Chara* and *Nostoc*.

The depth of water has alternated between 15 and 40 cm. The translucence of the greyish-white, muddy water was poor, generally from 1 to 2 cm, maximum 5 cm.

The upper 15 cm of the bottom was covered with fine silty-clayey sediment. The finest fraction could be demonstrated here in 38,2 percentage.

This distribution of the 174 individuals per taxonomical groups in all the samples is, as follows:

	per cent
Ceratopogonida	34,5
Nematoda	28,2
Coleoptera	12,1
Trichoptera	7,5
Chironomida	6,9
Diptera (Brachycera)	6,3
Odonata	2,3
Acari	1,7
Oligochaeta	0,6

The quantitative data of living animals, found in 18 quantitative samples are, as follows:

	individuals
Nematoda	40
Ceratopogonida	34
Coleoptera	12
Chironomida	6
Acari	1
Oligochaeta	1
Diptera	1

The smallest individual averge t.i. 5,4 individuals was characteristic of the zoobenthos of the lake.

The biotope close to the water-side proved also to be richer here both in quantitative and in qualitative relations.

In respect of the seasonal distribution, similarly to Kelemenszék, the zoobenthos production was characterized by the maximum in autumn. This was also caused by the increase in the individual number of Nematoda and of the Ceratopogonida larvae.

In the lake, there was only found one single Tubificida in the biotope close to the water-side *(Limnodrilus hoffmeisteri)*.

It can be established according to zoobenthos investigation into our natron lakes in the Great Hungarian Plain that the dominant fauna-elements of the bottom of saline waters are the members of Chironomidae, Ceratopogonidae, resp. — in Kisréti-tó — of the Oligochaeta taxongroups.

It is remarkable that the dominance of Ceratopogonidae alternates with that of Chironomidae: the increase of the individual number in one of these groups is connected with its decrease in the other. This can be observed not only in the case of samples taken from different natron lakes but also from the same lake.

On the bottom of the eutrophic fresh waters the Tubificidae species are generally the dominant fauna-elements of the zoobenthos. Their individual density is higher in waters rich in nutritive materials (e.g., in dead arms of the Tisza).

81,8 per cent of th e Oligochaeta fauna in the Kisréti-tó are the individuals of species belonging to the Tubificidae family. The dominant species is Limnodrilus

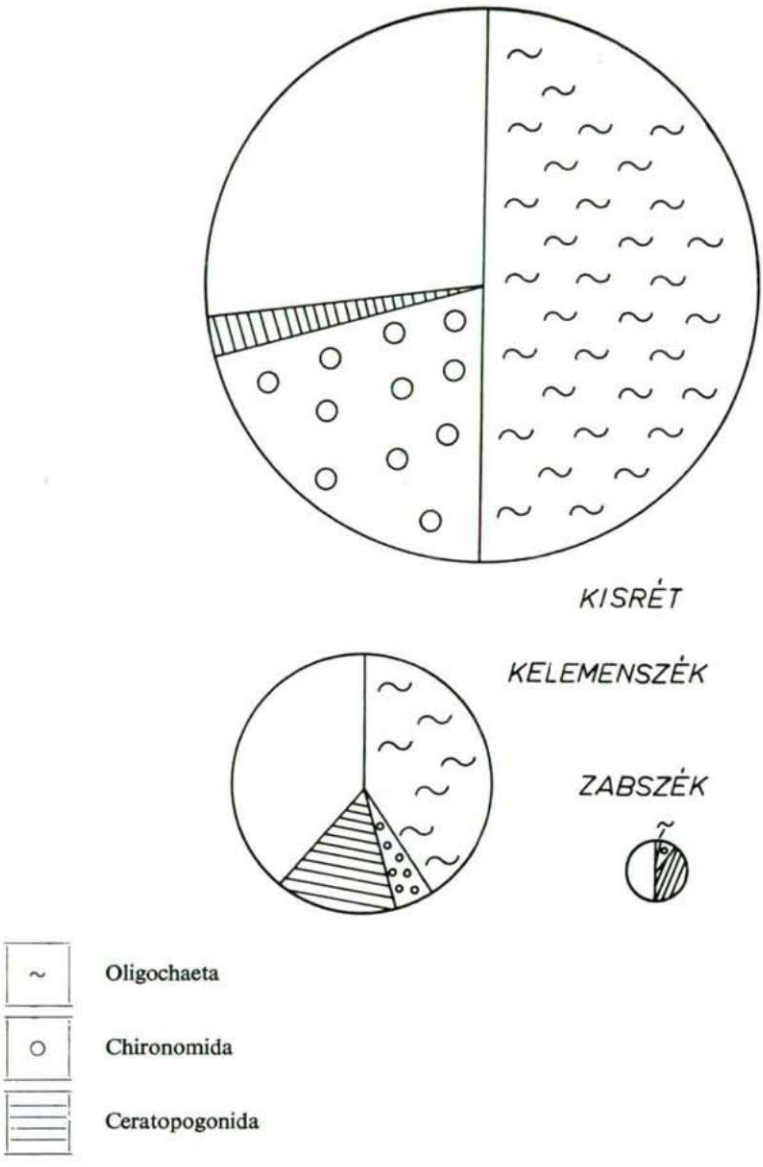

Fig. 1. The radius is in direct proportion to the individual number of zoobenthos

profundicola. Only 18,2 per cent belonged to the Naididae family. The dominant species was *Dero obtusa*. The majority of Naididae prefers the places grown over with water vegetation. In the Kisréti-tó 11,2 per cent of the Oligochaeta fauna of this

biotope while on the open-water vegetationless bottom only 4,2 per cent belonged to the Naididae species.

The distribution of animals within a biotope, according to species and individual numbers is determinated by the system of biotic and abiotic factors. The complex of factors mostly determining the zoobenthos fauna of our natron lakes is the extreme and considerable fluctuation of the waters main physiographical properties.

The decrease in water-level may have a drastic effect on the fauna on the bottom, too, particularly in shallow standing waters, even if no desiccation occurs. The surviving worms and other organinsms of the zoobenthos (e.g. Ceratopogonida and Brachycera larvae) can hide in the deeper and so still wet part of the bottom, where the tide over the unfavourable period. The possibility of survival can be ensured to the zoobenthos organisms by the deepenings in the uneven, pitted bottom of the lake, preserving water for a longer time.

The decrease in the individual number following the recession of water, e.g. in case of several Naidida species it is also explained by the decrease of the primary producent algae serving for nourishment (PFANNKUCHE, 1977).

Heterogenity is characteristic for our saline waters respect of the quality of sediment (bottom types) as well. By the data analysation of the size of granules it can be established that the sediment of the same lake can be of various types (e.g. in the Kisréti-tó the sand of small grains, in other places, on the bottom of the lake, the clayey mud was determinant). The type of sediment does not change consequently from the surface towards the deeper layer either.

Considering bottom types extreme eurytopes may be called from among Oligocheatae the majority of Limnodrilus species *(Limnodrilus hoffmeisteri, L. claparedeanus, L. udekemianus),* as well as *Tubifex tubifex.* With the refinement of sediment, the individual number of Oligochaetea rises, though the number of species shows a decreasing tendency.

In the sediment of the three saline waters, the bottom of open water was characterized by a higher percentage of sand, while the granule composition of the bottom close to the water-line can rather be characterized by the finer fraction.

The bottom of Kisréti-tó is of a sandy i.e. rougher sediment type which has been preferred by *Limnodrilus profundicola:* this fact is justified by its dominance there.

In connection with the vertical distribution of Oligochaeta, there are but few data in the literature. According to the recent investigations, it was established (PFANNKUCHE, 1977) that Tubificidae can be found in a maximum individual number at the lower border of the sediments oxidation zone.

It was observed (PFANNKUCHE, 1977) too, that in the upper sediment layer, juvenile Tubificidae are to be found in a higher number.

Naididae live generally on the surface of the sediment. The tube-dwelling Dero species are able to penetrate down deeper, but Naidida species do generally not occur deeper than 2 cm.

The maximum of the vertical distribution of Tubificidae can also be connected with these worms food requirement. In opposition to the earlier conception, they seem to consume certain (often anaerobic) bacteria or detritus selectively.

Investigating into the vertical distribution of Chironomida larvae we can establish that in our saline waters 80 per cent of the larvae dwell in the upmost sediment-

layer of 5 cm. But occasionally they are still to be found in a depth of 25—30 cm as well.

In periods of higher water the great majority of Ceratopogonida larvae live in the upper 5 cm of the sediment. In the wet or dry bottom the larvae retire deeper (15—20 cm), obviously making their escape from desiccation towards the wetter depths. This tendency characterizes both the biotopes close to the water-line and those in the middle of the bed.

It could be observed that in the samples close to the water-line taken from among the vegetation there were always comparatively somewhat more larvae in the upmost layers than in those taken from the plantless middle of the bed. This may be explained perhaps with the retarding effect of the higher vegetation of the coast close to the water-line resp. by the faster decrease in water of vegetationless places.

The sinking of water-level in natron lakes or their desiccation is an ecological factor complex strongly influencing several species. The drying up or desiccation of water and the consequent strongly changed environment (a high pH, sometimes over 10, rise in the redox-level of the mud, increased bacterial activity etc.) will only be survived by organisms which can tolerate these changes (e.g. Ceratopogonida, Brachycera). In the saline waters frozen in often to the bottom in winter the living world of the bottom is to be found, as a rule, in a comparatively lesser individual number. This can be due to the limiting effect of hydrogen sulphide, released sometimes below the ice.

The most frequent Tubificida species of Kisréti-tó are: Limnodrilus profundicola, L. claparedeanus, L. hoffmesiteri. All the three species are a-mesosaprobic organisms, and the joint occurrence of the two latter species in a higher individual number is known from hypertropic biotopes. From among these three cosmopolitan species L. profundicola the dominant species of saline waters could not be found in larger numbers in our other standing waters and in Hungarian rivers, as opposed to the other two species.

56—50 per cent of the individuals of L. profundicola collected in April and August 1976, were sexually mature. Several juvenile individuals in the samples taken in August 1977 may have belonged to this species as well. The reprodutive activity of L. claparedeanus achived its maximum in November 1976; their 33 per cent was then sexually mature.

It is worthy of note that during the same sampling the percentage of the entirely young Tubificida individuals was 75 per cent on the vegetation covered bottom close to the water-line, while in the vegetation-free biotopes farther from the water-side only 39 per cent of the worms were juvenile.

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